AIRDRIE • BEISEKER • BIGHORN • BLACK DIAMOND
BLACKIE • CALGARY • CANMORE • CAYLEY
CHESTERMERE LAKE • CLUNY • COCHRANE • CROSSFIELD
FOOTHILLS • GHOST LAKE • GLEICHEN • HIGH RIVER • HUSSAR
I.D. 48 • IRRICANA • LONGVIEW • OKOTOKS • ROCKY VIEW • ROCKYFORD
STANDARD • STRATHMORE • TURNER VALLEY • WAIPAROUS • WHEATLAND

# Prospect '89

## An Examination of Current Agricultural Practices and Government Initiatives

CALGARY REGIONAL PLANNING COMMISSION, SEPTEMBER 1989

# WIND EROSION AND SOIL SALINITY:

## An Examination of Current Agricultural Practices and Government Initiatives

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## Preface

This report in the Prospect series examines wind erosion and soil salinity factors in the Calgary region. Commission Members have, in the past, noted that attention needs to be paid to these issues and we hope that the report will provide benchmark data on which to monitor changes in future years. Although it may be difficult to minitor these changes on an annual basis, we do anticipate updating this information in the future.

We hope that the report will raise public awareness of the issue of soil degradation and improve communication between the public, the farming community, and other government and environmental agencies. Given the importance of agriculture to the region's employment and economic base, wind erosion and soil salinity are two issues worthy of examination.

## SOIL DEGRADATION

Recognizing that the problem of soil degradation is complex relating to climatic conditions, soil type, farming practices and existing policies and programs, the following is an outline of the two types of soil degradation common to our Region, the conservation practices that can be employed to minimize the process, and the trends toward encouraging conservation farming in terms of Provincial initiatives and programs. The report focuses on wind erosion and salinization as the two most prevalent forms of soil degradation in the Region.

## I. WIND EROSION

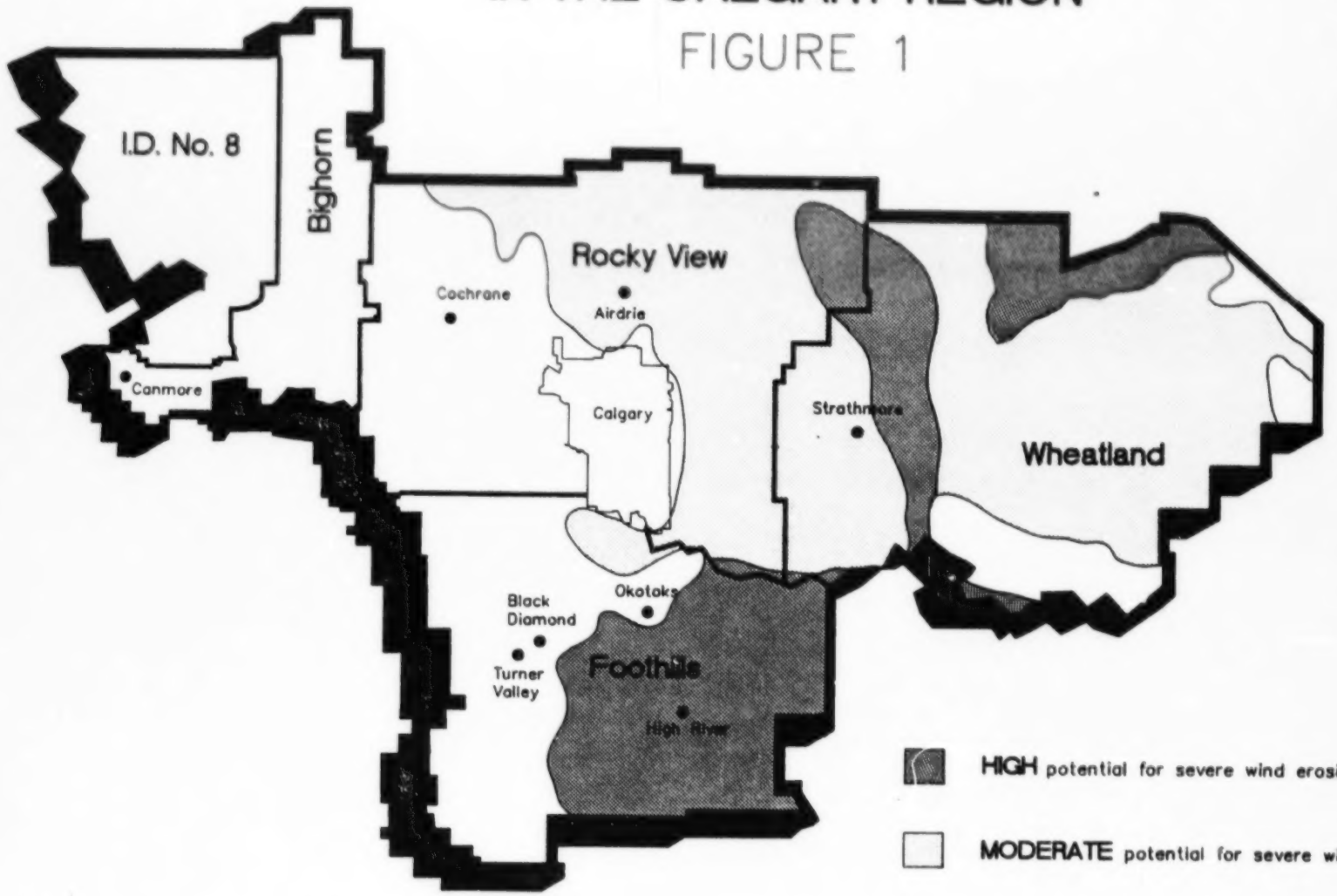
### 1. CAUSE

Figure 1 on page 2 has been adapted from an Agriculture Canada and Alberta Agriculture map of wind erosion potential in southern Alberta (1986). The majority of the Region in crop production has a moderate potential for wind erosion. The prime factor in this rating is that the crop production is typically good and subsequent residue cover is generally adequate enough to avoid higher risk of erosion. The areas of high potential for severe wind erosion generally experience erosive winds and crop residue levels are poor as a result of low cereal crop yields in the past.

In determining erosion potential by wind, wind speed, soil composition and structure, moisture content, surface roughness and degree of cover are all taken into consideration. As indicated, Figure 1 shows the potential of soils to be eroded by wind and focuses on the characteristics of the soil. Figure 2 on page 4 illustrates the soil erosion potential of winds and focuses on the characteristics of the winds. That is, the potential of wind to erode soil, unprotected as a result of traditional crop rotations and management techniques. Areas in the eastern portion of the Region have greater than 80% of the total land under cultivation with some pockets of 50%-79.9% of land under cultiva

# POTENTIAL FOR WIND EROSION IN THE CALGARY REGION

FIGURE 1




Source: Agriculture CANADA., Alberta Agriculture.
Boundary lines have been generalized.

tion. By overlaying the two maps, it is clear that portions of the County of Wheatland and the eastern part of the M.D. of Foothills are especially susceptible to soil erosion by wind.

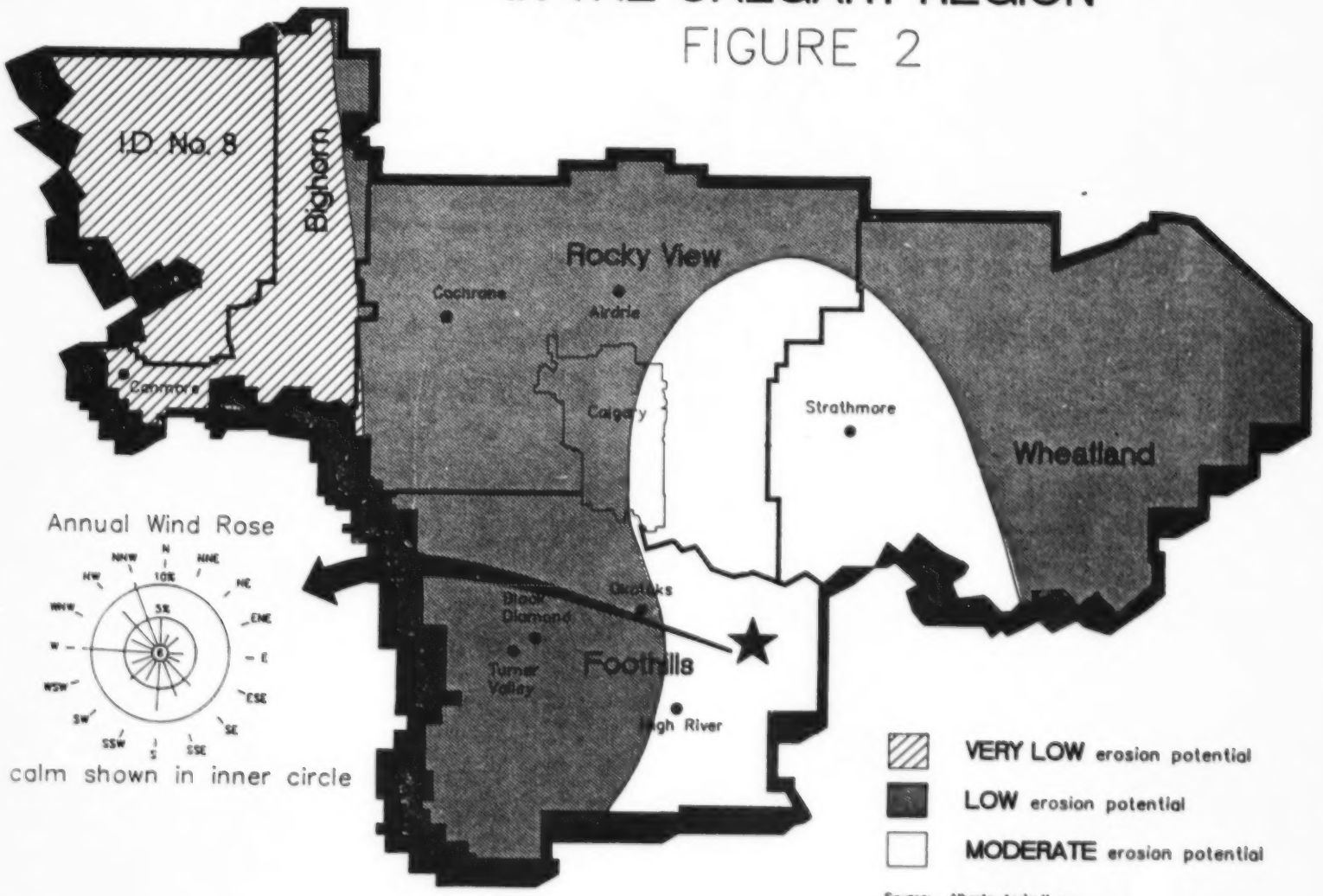
The risk of erosion can be minimized by proper management of the soil and cover crops. Soil erosion by wind is often associated with the practices of summer fallow, excessive tillage and the failure to maintain crop residues.[1]

The practice of summer fallow is employed primarily to control weeds, conserve soil moisture and regenerate soil fertility. Summer fallowing became widespread in the Prairie Provinces during the late 1800's and first half of this century with nearly 37 million acres of summer fallow in the three Prairie Provinces in 1970. Alberta typically has had some 6-7 million acres in summer fallow annually (see Table 1). The percent of improved land under summer fallow has remained fairly constant during the period from 1951 to 1976 at an average of 26% of the total cultivated acreage.[2]

The figures for the 1981 and 1986 census years illustrate a marked decrease in total summer fallow acreage. Typically, the number of acres under summer fallow relates to the level of soil moisture available in a given year. 1986 experienced higher precipitation than the years past or immediately following and this likely accounts for the decrease in areas summer fallowed. The years following 1986 experienced drier conditions and it is expected that the data in the forthcoming 1991 census will show a slight increase in summer fallow acreages.

# POTENTIAL FOR SOIL EROSION IN THE CALGARY REGION

## FIGURE 2




Source: Alberta Agriculture., Irrigation and Conservation Division.

Notes: The Wind Rose gives a diagrammatic analysis of the wind pattern at a given location with the length of each shaft portraying the average annual percentage frequency of the wind from 16 points of the compass.

Boundary lines have been generalized.

TABLE 1
Improved Land and Summer Fallow Acreage
in Alberta (1911-1986)
('000 Acres)

| Year | Improved Land | Summer Fallow | 3 as % of 2 |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| 1911 | 4352 | 251 | 5.77 |
| 1921 | 11768 | 2918 | 24.80 |
| 1931 | 17749 | 4547 | 25.62 |
| 1941 | 20125 | 6546 | 32.53 |
| 1951 | 22271 | 6195 | 27.82 |
| 1956 | 23746 | 7091 | 29.86 |
| 1961 | 25289 | 7450 | 29.46 |
| 1966 | 27276 | 6659 | 24.41 |
| 1971 | 28460 | 7009 | 24.63 |
| 1976 | 29136 | 6451 | 22.14 |
| 1981 | 30951 | 5450 | 17.61 |
| 1986 | 31891 | 5256 | 16.48 |

Source: Adapted from: Factors Affecting Summerfallow Acreage in Alberta; Environment Council of Alberta

To focus this trend on our Region, Table 2 was produced for the County of Wheatland, M.D. of Rocky View and M.D. of Foothills to compare the percentage of summer fallow land to other uses for improved land and to illustrate the trend toward a decrease in summer fallowed land as a percentage of improved lands. Both the M.D. of Foothills and the County of Wheatland have experienced a decrease in the percentage of summer fallowed land with an increase in the amount of land under crop production. The M.D. of of Rocky View also experienced a decline in the amount of lands summer fallowed but the amount of land under crop production declined as well.

Figure 3, Total Cultivated Acreage and Summer fallow Acreage in Alberta, illustrates the peaks in summer fallow acreage. As illustrated, the amount of land summer fallowed has remained fairly

TABLE 2
Improved Land and Summer Fallow Acreages in the Calgary Region
1971-1986

County of Wheatland #16

| | Total Improved Land | Summer Fallow | % of 1 | Crops | % of 1 | Pasture | % of 1 | Other | % of 1 |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | | 3 | | 4 | | 5 | |
| 1971 | 877,864 | 291,368 | 33.2 | 517,851 | 59.0 | 55,910 | 6.4 | 12,735 | 1.5 |
| 1976 | 892,058 | 274,228 | 30.7 | 543,382 | 60.9 | 65,175 | 7.3 | 9,237 | 1.0 |
| 1981 | 920,758 | 222,979 | 24.2 | 609,058 | 66.1 | 79,013 | 8.6 | 9,708 | 1.1 |
| 1986 | 915,187 | 215,406 | 23.5 | 630,608 | 68.9 | 60,009 | 6.6 | 9,164 | 1.0 |

M.D. of Foothills #31

| | Total Improved Land | Summer Fallow | % of 1 | Crops | % of 1 | Pasture | % of 1 | Other | % of 1 |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | | 3 | | 4 | | 5 | |
| 1971 | 509,506 | 102,711 | 20.2 | 315,947 | 62.0 | 80,330 | 15.8 | 10,518 | 2.1 |
| 1976 | 492,511 | 72,049 | 14.6 | 341,035 | 69.2 | 69,755 | 14.2 | 9,672 | 2.0 |
| 1981 | 541,923 | 57,002 | 10.5 | 384,309 | 71.0 | 84,740 | 15.6 | 15,872 | 3.0 |
| 1986 | 553,591 | 46,241 | 8.4 | 518,916 | 93.7 | 72,135 | 13.0 | 11,962 | 2.2 |

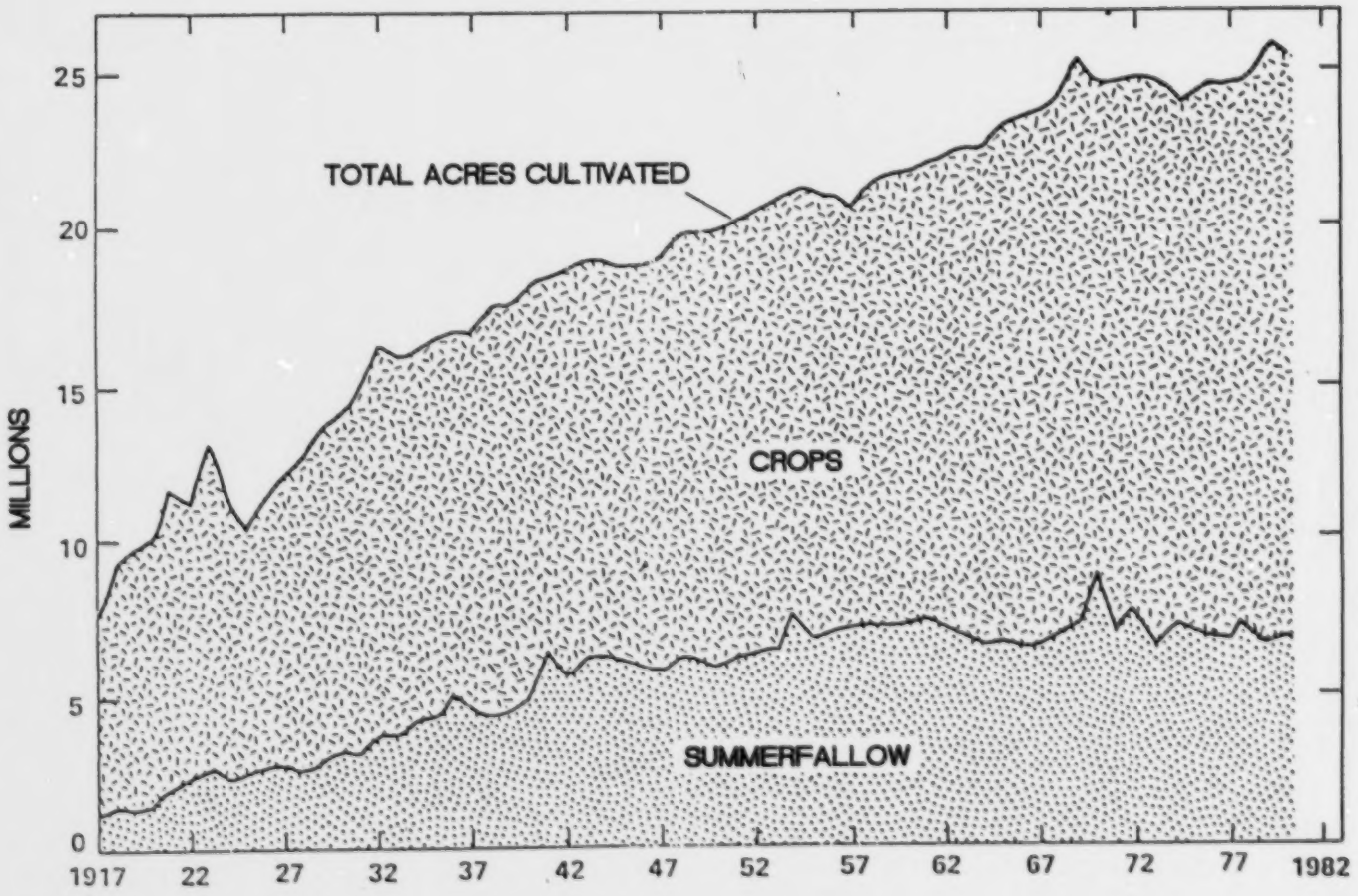
M.D. of Rocky View #44

| | Total Improved Land | Summer Fallow | % of 1 | Crops | % of 1 | Pasture | % of 1 | Other | % of 1 |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | | 3 | | 4 | | 5 | |
| 1971 | 699,113 | 152,408 | 21.8 | 460,996 | 66.0 | 70,950 | 10.1 | 14,759 | 2.1 |
| 1976 | 687,506 | 121,890 | 17.7 | 473,414 | 69.0 | 79,481 | 12.0 | 12,721 | 1.9 |
| 1981 | 729,647 | 95,751 | 13.1 | 501,150 | 69.0 | 113,689 | 15.6 | 19,057 | 2.6 |
| 1986 | 676,990 | 65,850 | 9.7 | 281,535 | 42.0 | 78,503 | 12.0 | 13,721 | 2.0 |

Source: Census of Agriculture for Alberta 1971, 1976, 1981, 1986. Alberta Agriculture.

# TOTAL CULTIVATED ACREAGE AND SUMMER FALLOW ACREAGE IN ALBERTA

FIGURE 3




Source: Factors Affecting Summer Fallow Acreages in Alberta; Environment Council of Alberta; 1981

constant at approximately 6-7 million acres for the last 30 years while the total acres cultivated has increased by at least 30%. The peaks can be correlated to particularly dry years historically.

The extent of land under summer fallow in the Province can be influenced by three main factors: soil moisture, age of farmer, and increased awareness of the long-term negative effects of summer fallowing.

Soil Moisture

Alberta Agriculture produces Fall Stubble Soil Moisture Maps at the end of each season on an annual basis and began producing Spring Stubble Soil Moisture Maps in 1988. The maps on pages 10 to 15 have been adapted for the Region from the Alberta Agriculture Maps and show the general level of soil moisture on stubble land. For the time period that these maps are available, the soil moisture conditions for the Calgary Region vary from high to medium throughout most of the Region and from medium to very low at locations in the eastern part of the County of Wheatland.

Although specific data for the last two growing seasons is not available, Alberta Agriculture states that the percent of cropland in summer fallow over the 1987-1988 season has increased slightly. It would be reasonable to relate this to the low spring soil moisture conditions experienced. Also, last year's drought has seriously affected the yields expected and could consequently contribute to an increase in summer fallow acreages this year. Approximately half of the farmed acreages in Alberta have experienced a crop yield decrease as a result of the very dry conditions. The very dry soil conditions that will be expected in the spring plus the tendency, under these conditions, to summer fallow will dramatically increase the soil erosion problem. The increased precipitation (snow accumulation) over the

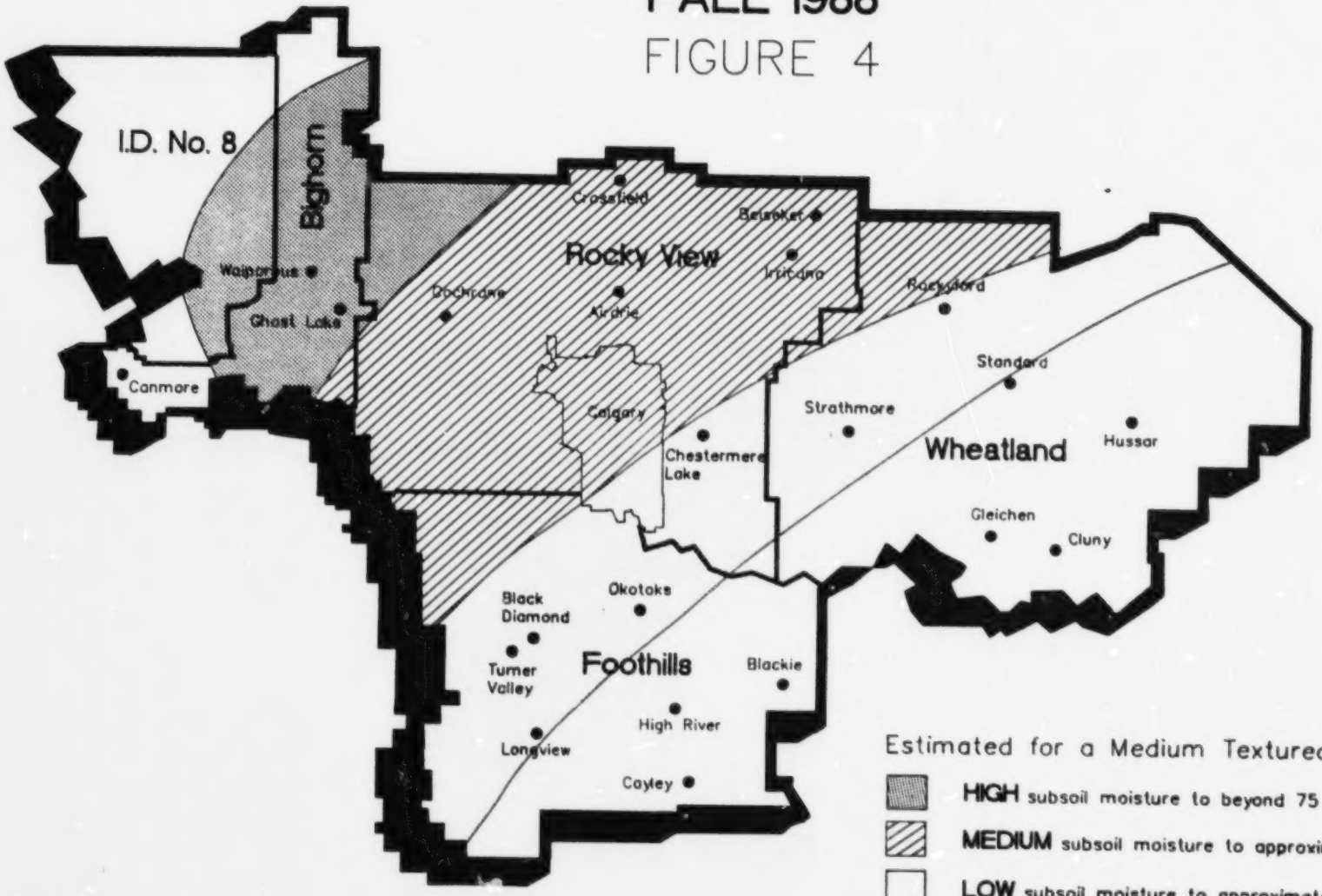
1988-1989 winter will not be sufficient to end the drought conditions experienced by much of the province.[3] The higher percentage of fallow acreage outlined in Table 2 for the County of Wheatland suggests a correlation to soil moisture deficits. Improving soil quality and weed control are other traditional reasons for employing summer fallowing. It is agreed that summer fallow increases the release of nitrates into the soil during fallow and this translates to higher yields when the land is cropped. However, soil erosion by wind, as accelerated by summer fallowing, reduces fertility by removing the fine textured soil particles that are rich in nutrients and the organic matter, thus reducing soil fertility in the long term.

Alberta Agriculture maintains that weed control is no longer a significant factor in employing summer fallow. The trend appears to be that more farmers are taking advantage of slightly lower herbicide costs and specially designed weed control programs rather than tilling to control weeds.

Age of Farmer

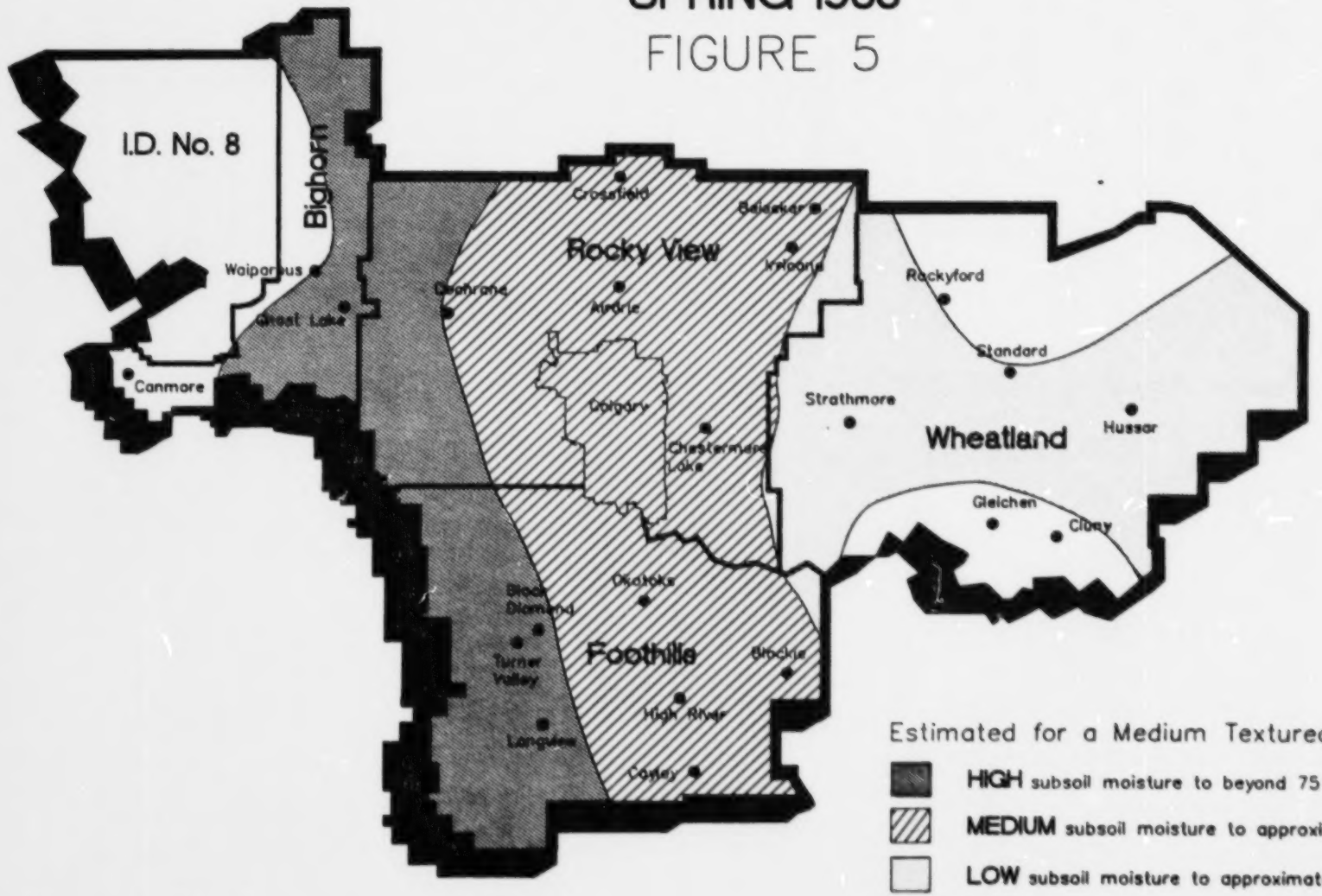
Table 3 on page 17 outlines the average age of farm operators for the Province, and for three rural municipalities in the Region. It has been suggested that the age of farm operators may have some bearing on the ready adoption of new conservation farming techniques. That is, the younger farmer may be more likely to take the risk of changing from the traditional crop - fallow rotation to minimum tillage or continuous cropping. However, the number of young farmers under 25 is decreasing both in our Region and province-wide. The 25-34 and 35-44 age groups are increasing but the farmers in the +70 age group have nearly doubled in the M.D.'s of Foothills and Rocky View (1971-1986). In light of this, we believe that the age of farm operator may not be a strong factor in the trend away from summer fallow. Increased

# STUBBLE SOIL MOISTURE
# FALL 1988
## FIGURE 4




Source: Alberta Agriculture, Conservation and Development Branch
Adapted from: Stubble Soil Moisture Maps
Boundary lines have been generalized.

# STUBBLE SOIL MOISTURE
# SPRING 1988
## FIGURE 5

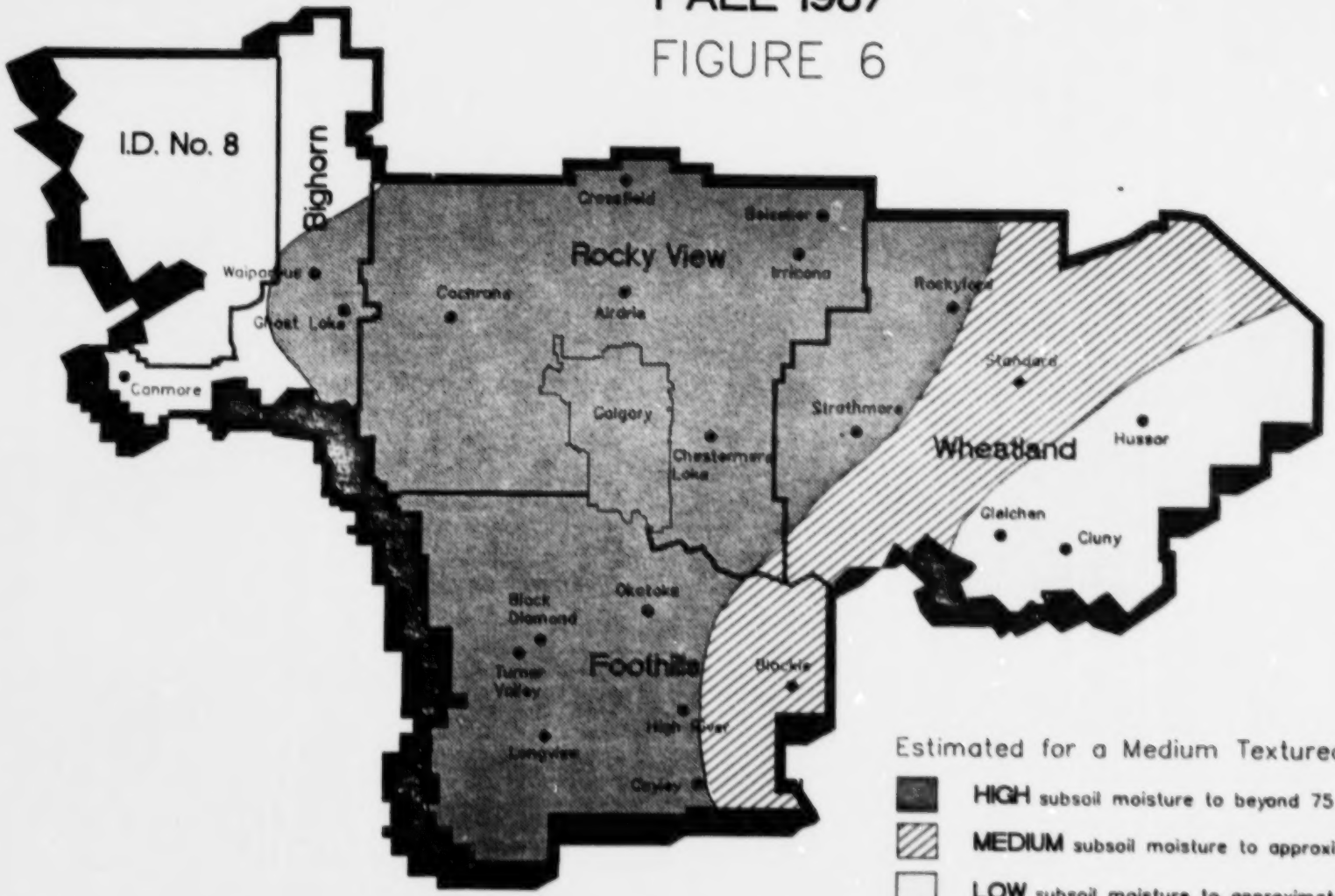



Estimated for a Medium Textured Soil

- **HIGH** subsoil moisture to beyond 75 cm
- **MEDIUM** subsoil moisture to approximately 45–75 cm
- **LOW** subsoil moisture to approximately 45 cm
- **VERY LOW** little or no available water below 15 cm

Source: Alberta Agriculture, Conservation and Development Branch
Adapted from: Stubble Soil Moisture Maps
Boundary lines have been generalized.

# STUBBLE SOIL MOISTURE
# FALL 1987
## FIGURE 6




Estimated for a Medium Textured Soil

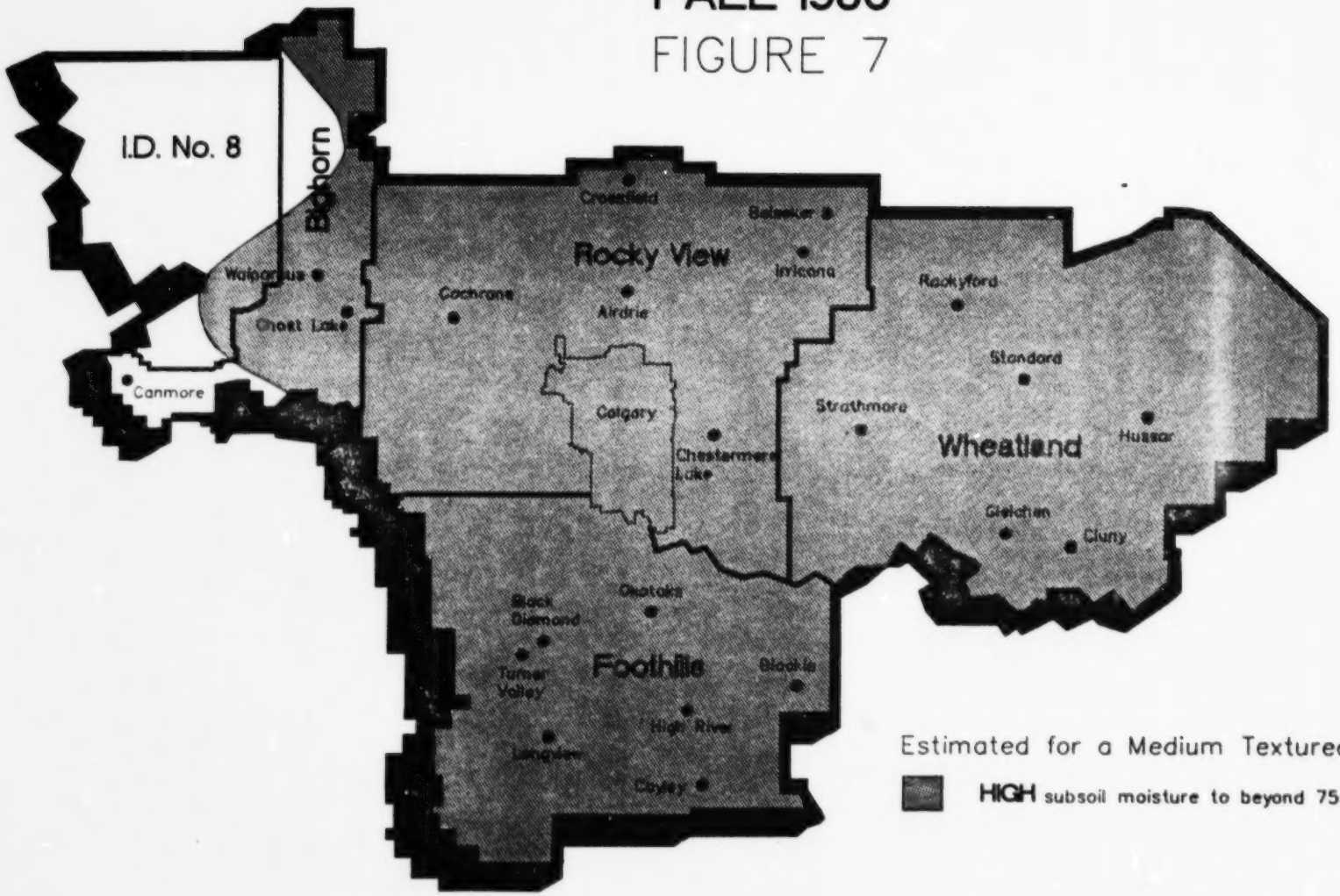
- **HIGH** subsoil moisture to beyond 75 cm
- **MEDIUM** subsoil moisture to approximately 45–75 cm
- **LOW** subsoil moisture to approximately 45 cm

0 5 10 20 30

Kilometres

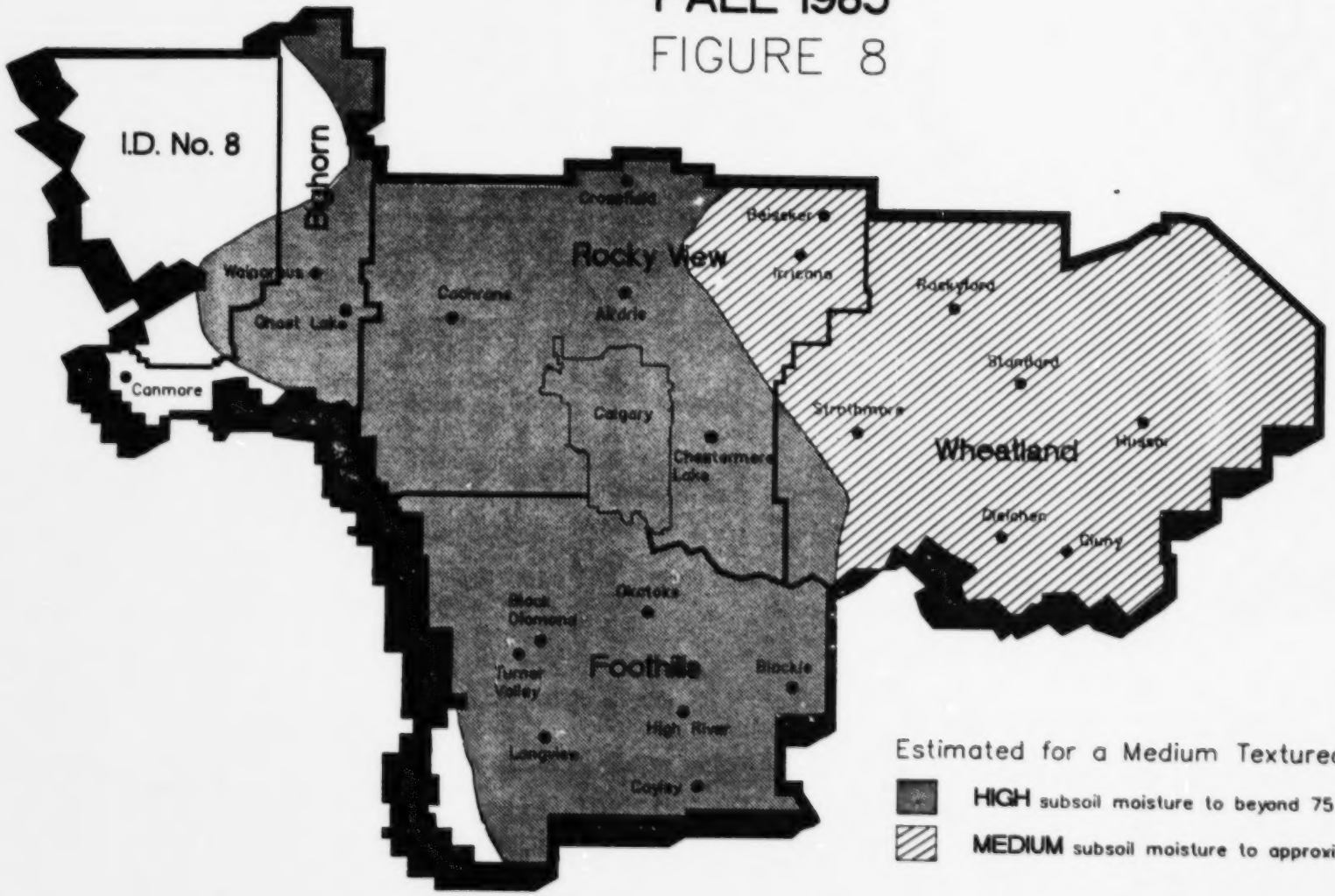
Source: Alberta Agriculture, Conservation and Development Branch
Adapted from: Stubble Soil Moisture Maps
Boundary lines have been generalized.

# STUBBLE SOIL MOISTURE
# FALL 1986
## FIGURE 7



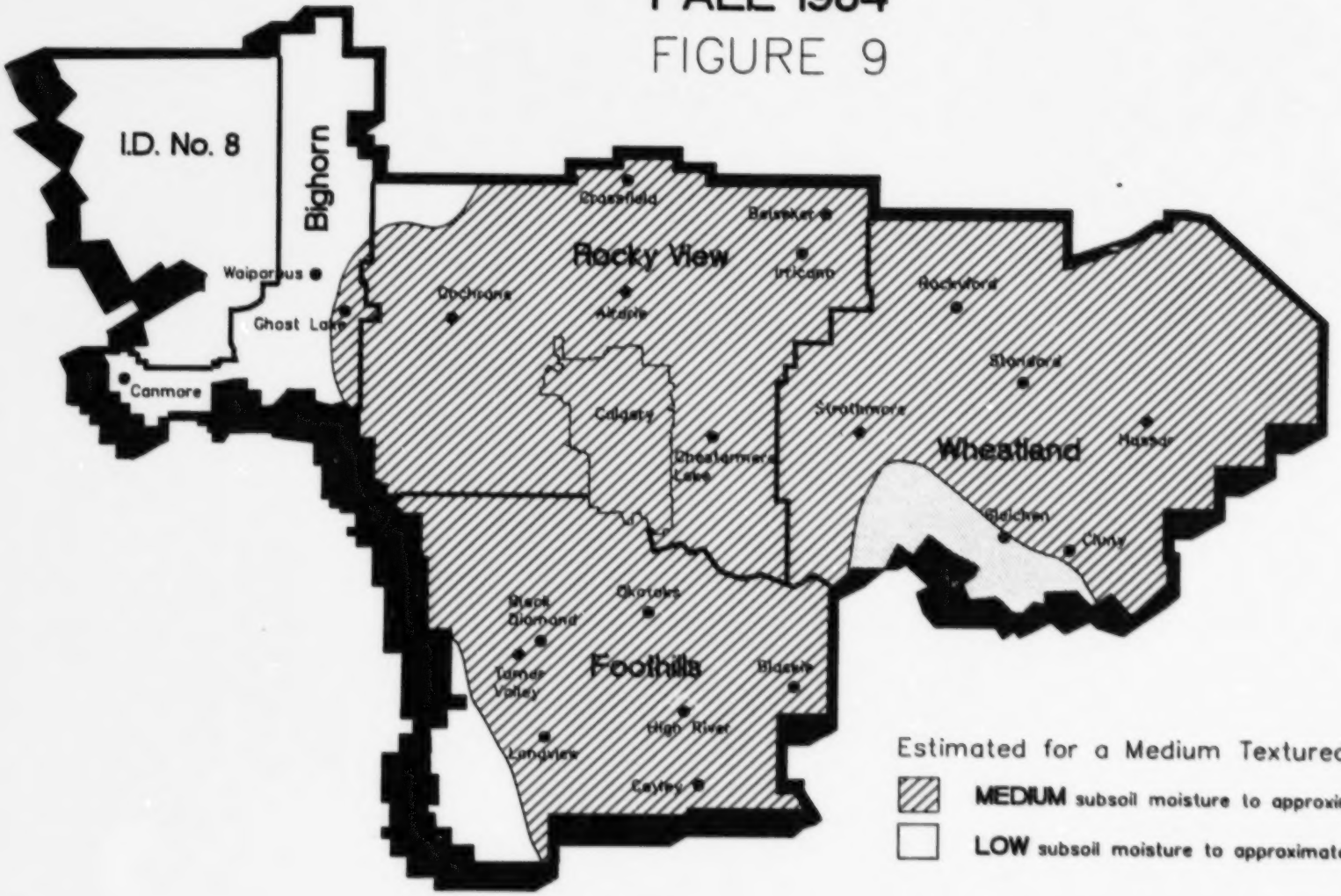

Source: Alberta Agriculture, Conservation and Development Branch
Adapted from: Stubble Soil Moisture Maps
Boundary lines have been generalized.

# STUBBLE SOIL MOISTURE
# FALL 1985
## FIGURE 8




Source: Alberta Agriculture, Conservation and Development Branch
Adapted from: Stubble Soil Moisture Maps
Boundary lines have been generalized.

# STUBBLE SOIL MOISTURE
# FALL 1984
## FIGURE 9




Source: Alberta Agriculture, Conservation and Development Branch
Adapted from: Stubble Soil Moisture Maps
Boundary lines have been generalized.

awareness from programs and seminars and increased acceptance and use of Provincially sponsored assistance programs throughout all age groups may be more of a governing factor toward increasing the trend away from summer fallowing. These will be discussed in the Appendix on POSITIVE ACTION.

## 2. CONTROL

In order to control wind erosion, two basic rules are emphasized by Alberta Agriculture:

- maintain good soil structure
- maintain optional "trash" cover (residue)

Hoechst Canada Inc. recommends that ongoing soil conservation practices focus on a four-part system:[4]

- conservation tillage
- zero incorporation
- snowmelt management
- flexible cropping

### (i) Conservation Tillage

Conservation tillage is a general term that relates to various degrees of tillage that serve to retain residue, decrease the risk of erosion and increase moisture retention. The weeds are controlled by varying degrees of herbicide application and crops are seeded into the undisturbed stubble of the previous crop.

TABLE 3
Age of Farm Operator in Alberta and the Calgary Region

| | under 25 | 25-34 | 35-44 | 45-54 | 55-59 | 60-64 | 65-69 | +70 | Total |
|---|---|---|---|---|---|---|---|---|---|
| Province | | | | | | | | | |
| 1971 | 1,591 (2.5%) | 8,915 (14.2%) | 15,088 (24.1%) | 17,930 (28.6%) | 7,225 (11.5%) | 5,684 (9.1%) | 3,638 (5.8%) | 2,631 (4.2%) | 62,702 |
| 1976 | 2,058 (3.6%) | 9,204 (16.1%) | 13,614 (23.8%) | 15,711 (27.4%) | 6,607 (11.5%) | 4,960 (8.7%) | 2,832 (4.9%) | 2,324 (4.1%) | 57,310 |
| 1981 | 2,011 (3.5%) | 10,419 (18.0%) | 13,664 (24.0%) | 15,075 (26%) | 5,568 (11.3%) | 5,045 (8.7%) | 3,005 (5.2%) | 2,267 (3.9%) | 58,054 |
| 1986 | 1,507 (2.6%) | 9,887 (17.0%) | 13,247 (23.0%) | 13,935 (24.1%) | 6,833 (12.0%) | 5,637 (9.8%) | 3,506 (6.1%) | 3,225 (5.6%) | 57,777 |
| County of Wheatland #16 | | | | | | | | | |
| 1971 | 33 (3.6%) | 167 (18.1%) | 213 (23.0%) | 269 (29.1%) | 90 (9.7%) | 73 (7.9%) | 42 (4.5%) | 38 (4.1%) | 925 |
| 1976 | 33 (4.0%) | 148 (18.0%) | 203 (24.3%) | 231 (28.0%) | 104 (12.5%) | 52 (6.2%) | 44 (5.3%) | 14 (2.3%) | 834 |
| 1981 | 25 (2.8%) | 190 (21.0%) | 238 (26.3%) | 217 (24.0%) | 87 (9.6%) | 76 (8.4%) | 37 (4.1%) | 36 (4.0%) | 906 |
| 1986 | 29 (3.2%) | 170 (18.8%) | 236 (26.1%) | 198 (22.0%) | 95 (11.0%) | 71 (7.8%) | 61 (6.7%) | 45 (5.0%) | 905 |
| M.D. of Foothills #31 | | | | | | | | | |
| 1971 | 27 (2.5%) | 138 (13.0%) | 247 (22.6%) | 282 (26.0%) | 147 (13.4%) | 120 (11.0%) | 76 (7.0%) | 56 (5.1%) | 1,093 |
| 1976 | 26 (2.5%) | 165 (16.0%) | 215 (20.3%) | 288 (27.2%) | 117 (11.1%) | 116 (11.0%) | 73 (7.0%) | 56 (5.3%) | 1,056 |
| 1981 | 16 (1.4%) | 166 (14.3%) | 248 (21.3%) | 335 (29.0%) | 137 (12.0%) | 94 (8.1%) | 85 (7.3%) | 81 (7.0%) | 1,162 |
| 1986 | 12 (0.9%) | 158 (13.0%) | 276 (23.0%) | 265 (22.0%) | 174 (14.4%) | 106 (8.7%) | 96 (8.0%) | 125 (10.3%) | 1,212 |
| M.D. of Rocky View #44 | | | | | | | | | |
| 1971 | 25 (1.7%) | 214 (15.0%) | 374 (26.0%) | 391 (27.0%) | 165 (11.4%) | 130 (9.0%) | 84 (6.0%) | 64 (4.3%) | 1,447 |
| 1976 | 30 (2.3%) | 203 (16.0%) | 298 (23.0%) | 350 (27.0%) | 147 (11.3%) | 107 (8.2%) | 99 (7.5%) | 70 (5.4%) | 1,304 |
| 1981 | 23 (1.6%) | 210 (15.5%) | 344 (24.2%) | 400 (28.1%) | 147 (10.3%) | 139 (10.0%) | 83 (6.0%) | 75 (5.3%) | 1,421 |
| 1986 | 19 (1.4%) | 176 (13.0%) | 320 (23.2%) | 347 (25.1%) | 183 (13.3%) | 120 (8.7%) | 97 (7.0%) | 117 (9.0%) | 1,379 |

Conservation tillage minimally disturbs crop residue and therefore contributes to increasing organic matter, providing excellent control for soil erosion.

(ii) Zero Incorporation

This emphasizes replacing tillage or summer fallowing totally with chemical application for weed control. However, by reducing tillage or continuous cropping, new herbicide resistant weeds may emerge.

(iii) Snow Management

Proper management of snow and snowmelt in the spring should, in many areas of our Region, be sufficient to provide adequate moisture and eliminate the need for summer fallow for this purpose. The following Table 4 on page 19 illustrates various snow management methods as outlined by Alberta Agriculture.

(iv) Flexible Cropping

Flexible cropping or crop rotation typically includes cereal, grass and legume mixtures that have greater production than crop-fallow rotations. The success of recropping is dependent on adequate soil moisture and this relates to moisture or snow management practices.

Yields from recropping on stubble can reach 85% of a summer fallow field. The use of forages in a flexible cropping system tend to stabilize soil organic matter and organic matter decomposition is decreased with reduced tillage.[5]

In addition, other related methods can be employed to help reduce wind erosion.

TABLE 4
Snow Management Methods

| Method of Snow Management | Precipitation Storage Level as %* Range | Average | Comment |
|---|---|---|---|
| 1. Stubble conservation | 25 - 50 | 45 | This method is simply the conservation of existing stubble with one fall cultivation. No additional farm costs will occur. |
| 2. Noncompetitive barriers | | | |
| • Snow ridging | 25 - 50 | 45 | Fields are snow plowed across the prevailing wind direction to create snow ridges which catch further snow. Results have not been consistent. |
| • Tall stubble | 25 - 55 | 50 | Crop is harvested leaving a 25 - 30 cm stubble to catch snow. Seeding requires equipment suited to heavy trash. Little additional costs should occur. |
| • Alternative height stubble | 25 - 60 | 55 | Stubble is cut at alternative heights 10 - 15 cm and 25 - 30 cm. Most conveniently done by two swathers or a combine. |
| • Standing grain strips | 30 - 70 | 65 | Several rows of standing grain are left. This may be done each round or after two rounds. A small decrease in current yield but no additional cost is incurred. |
| • Deflectors on combine or swather | 30 - 65 | 60 | Deflectors on cutting bar leave a strip of stubble with only head removed on each machine pass. A tall crop is generally required to be effective. Little additional cost will be incurred. |
| • Combine or swather attachments | 30 - 70 | 65 | Requires purchase of special equipment. Strips are left on each machine pass. |
| 3. Competitive barriers | | | |
| • Grass barriers | 30 - 70 | 65 | Permanent grass barriers of wheat grass are established. Some cost involved in grass establishment and maintenance. Barriers occupy a small amount of land. |
| • Annual crop barriers | 25 - 65 | 55 | Barriers are seeded on fallow in mid July and increase snow catch during the following winter. Requires narrow seeder to plant several crop rows. Can be employed on summer fallow. |
| • Shelterbelts | 25 - 50 | 45 | Shelterbelts provide a permanent barrier. They require establishment, maintenance and occupy land. Snow accumulation is often variable and not uniformly distributed. |

TABLE 4 (continued)
Snow Management Methods

| Method of Snow Management | Precipitation Storage Level as %* Range | Average | Comment |
|---|---|---|---|
| 4. Deep cultivation | Soils that crack can store 25% more water than soils that do not crack | | Artificial cracks can be produced by several tools, such as the rippers or paraplows. The cracks remain active for several years. The economics of such tillage practices have not been established. Deep tillage can be expensive. |

* These storage efficiencies are for soils in the Dark Brown and Brown Soil Zones. Other soil zones may exhibit somewhat lower storage as will the area with frequent Chinooks.

Source: Alberta Agriculture; Agdex 510-1; Aguust 1987.

(v) Cover Crops

Crops, generally oats, barley, fall rye, winter wheat or clover can be seeded in mid summer to reduce soil erosion during the winter and to provide pasture or saleable crop.

(vi) Trash Cover Farming

The quantity of trash (residue) required to protect soil varies with wind velocity and the amount of erodible material on the surface.

The total weight of the standing stubble and combined straw produced with each pound of grain is expressed as the straw/grain ratio. The ratio is useful in determining, based on yield, the quantity of residue that could be utilized to prevent erosion and if other mitigating measures would be necessary. Straw/grain ratios are illustrated for the Black and Dark Brown Soil Zones of our Region on Table 5 on page 21.

## 3. IMPEDIMENTS TO CONTROL

The preceding sections have outlined some of the alternatives to summer fallowing to reduce the risk of soil erosion. These practices are being actively promoted by Alberta Agriculture. The recent trend in reducing the total acreage under summer fallow can be at least partially attributed to the Alberta Agriculture programs. The general consensus is that most farmers are concerned about soil erosion but short-term economic constraints impede change. Substantial risks are identified with adopting new cropping systems and these are regarded as impediments to changing traditional practices like summer fallow. Over the long-term, conservation farming practices are proven to be cost effective but the transition period is the hardest to overcome in terms of increased input costs and increased risk.

TABLE 5
Straw/Grain Ratios

| Crop | Soil Zone | Pounds of Residue | Pounds of Grain |
|---|---|---|---|
| Wheat on | Black Soil | 2.0 - 1.5 | 1.0 |
| on | Dark Brown Soil | 1.6 - 1.0 | 1.0 |
| Oats | | 1.5 | 1.0 |
| Rye | | 1.5 | 1.0 |
| Barley | | 1.0 | 1.0 |

Source: Adapted from: Agriculture Canada: Soil Erosion By Wind - Cause, Damage, Control; Publication 1266; 1966

The following is an outline of some of the major concerns expressed by farmers in the area in adopting new cropping systems or conservation farming techniques. The information was gained from interviews with staff of Alberta Agriculture at all levels, local municipal staff and elected representatives in the agricultural industry and the proceedings of the Soil at Risk Conference held in Hanna in 1986. The comments given in the following pages do not necessarily represent the views of the Calgary Regional Planning Commission.

(i) Research/Technology Transfer

The economic viability of new cropping systems must be supported by field confirmation geared to local conditions. The trend is moving toward acceptance of new cropping systems but the focus of current research is on detailed soil science research rather than implementation strategies at the farm level.[6]

(ii) Farming Misconceptions

The attitude that continuous cropping is "hard on the land" and that chemical agriculture is bad still exists among producers. Particularly in dry years when the yield from summer fallow is considerably better than the yield from stubble, the misconception is reinforced.

The above two points are listed as impediments to active control of soil erosion by wind. However, it is difficult to categorize these or measure their effects. Conservation farming is a management strategy based on the attitude of the farmer and his will to change.

The following points are recognized impediments to control that can be readily identified and specific suggestions for improvement can be made.

(iii) Cereal Grain Quotas

Wheat Board quotas were originally established to promote orderly marketing and control production for the equitable distribution of available grain sales among producers. The problem identified with the quota system is that quotas were based on the amount of cultivated (worked) acreage, not on seeded acreage. This has the effect of encouraging summer fallow, particularly in years of high stocks in farm storage. A minor adjustment was made to the quota system recently to include a productivity factor whereby bonuses were provided for seeded areas. However, this also has negative implications in that it encourages farmers to break and seed marginal land. Also, land taken out of cereal crop production and seeded with forage such as alfalfa, for the purpose of enhancing soil nitrogen in a continuous cropping system or reducing soil moisture in saline prone areas, does not come under the quota system.

(iv) Alberta Hail and Crop Insurance Program

This program is designed to compensate farmers for crop loss due to natural causes such as drought or hail. The program tends to discriminate against those farmers using a continuous cropping system. That is, insurance payouts for lost

crops planted on stubble are less than for lost crops planted on summer fallow. In order for more farmers to adopt a continuous cropping system, it is felt that the program must assist in absorbing more of the risk. Again, forage crops planted in concert with the soil conservation management programs are not covered.

(v) Western Grain Transport Act

Although this is not a significant factor in impeding the control measures for wind erosion, the subsidization of transport costs for Western grain to export tends to discourage the production of livestock. Livestock production would be a better use for some of the marginal land being brought into production and provide a market for rotation crops of forage and grain.

(vi) Western Grain Stabilization Program

The Western Grain Stabilization Program needs to be expanded to recognize regional variations in production levels and to better reflect commodity prices to encourage diversification in farming operations. Continued low produce prices encourage the practice of summer fallow. The abundance of grain on the world market may affect the feasibility of recropping practices. That is, the market cannot absorb the increased production that would result in the increased yields from recropping.

(vii) Assistance and Incentives

For a farmer to seriously adopt the conservation farming practices for the long-term, equipment, fertilizer and herbicide costs are important factors. Product prices are the key to increased adoption of conservation farming practices.

The chemical patent laws currently ensure a seventeen year patent life for herbicides. These should be changed to reduce patent life, increase competition and subsequently reduce costs. Taxes currently included in fertilizer and herbicide costs should be reduced or tax credits applied when the farmer can demonstrate that the increased use of these products is part of a conservation farming system. The patents on many of the herbicides will be lifted within the next couple of years and it is expected that the cost of these herbicides will drop dramatically. It would, therefore, be reasonable to suggest that the use of herbicides will increase and summer fallow for weed control will continue to decrease over time.

## II. SALINITY

Salinity occurs in two forms: natural salinity and secondary salinity. Natural salinity occurs in areas with a high water table downslope from recharge areas. Man's activities can aggravate the salinity problem by creating conditions that facilitate excess water in the recharge area. Secondary salinity is often equated with irrigation systems and canal seepage. Figure 10 on page 26 illustrates the areas of both types of salinity in the Calgary Region.

It is estimated that approximately 3 million acres of dry land in Alberta are affected by salinity with average crop yield reductions of 25%.[7] There are various types of dry land seep, but the overriding cause is excess water in the recharge area.

Secondary salinity problems are often equated with irrigated land. Less than 4% of the arable land in Alberta is irrigated but this area produces 20% of the Province's agricultural products.[8] However, the proper management of saline soils on irrigated lands is essential to maintain the productivity of the land and the soil resource.

### 1. CAUSE

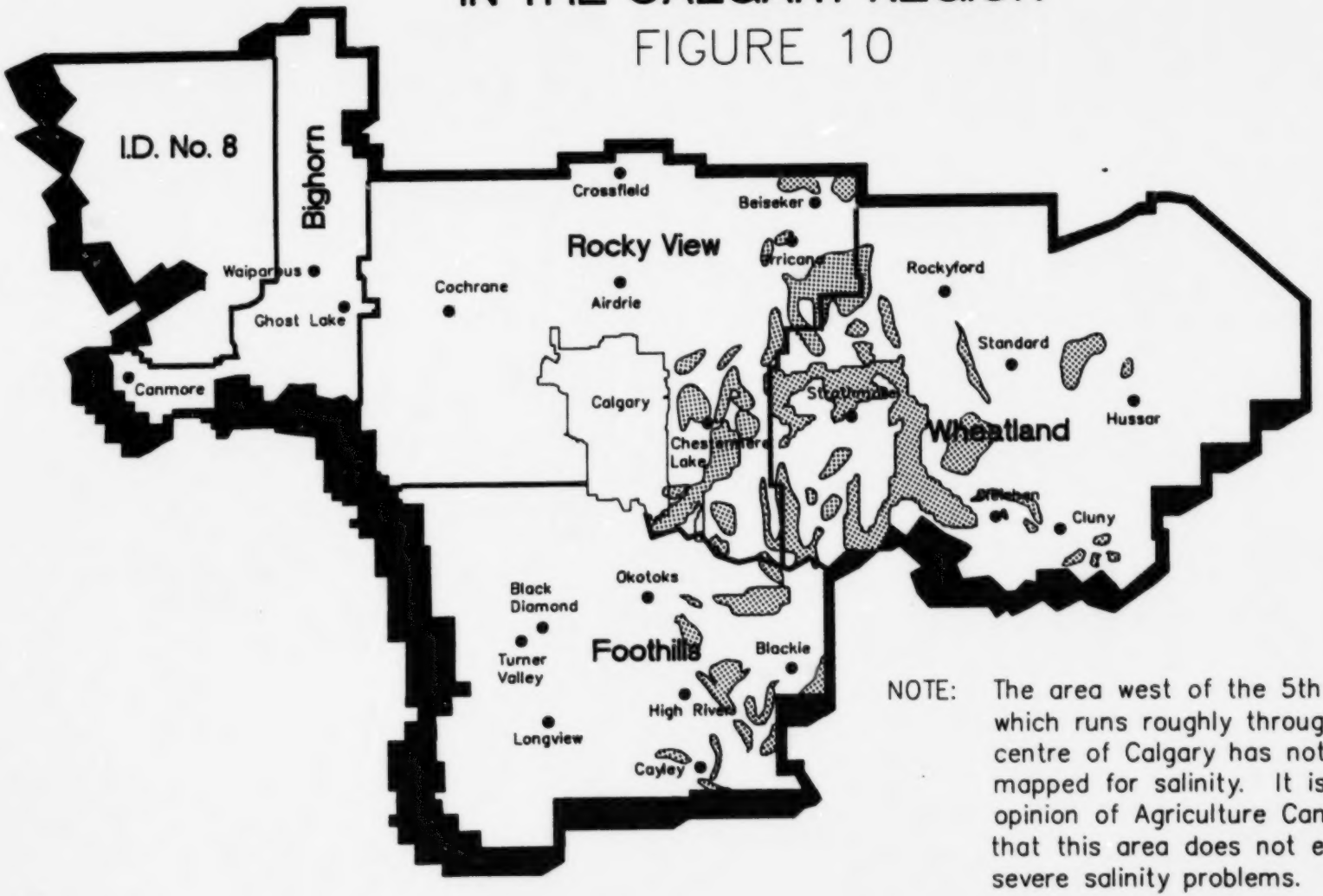
The presence of excess water in the recharge area can be the result of one or a combination of the following factors.

(a) Deep tillage or summer fallow. The widespread use of the two year crop - fallow rotation in the recharge area is a common cause of saline seep downslope. Continuous cropping utilizes soil moisture to the fullest extent, and reduces water percolation into the water table.

(b) Water and snow accumulation.

# AREAS OF NATURAL AND SECONDARY SALINITY IN THE CALGARY REGION

## FIGURE 10




NOTE: The area west of the 5th Meridian which runs roughly through the centre of Calgary has not been mapped for salinity. It is the opinion of Agriculture Canada that this area does not experience severe salinity problems.

Source: Agriculture Canada Research Station Lethbridge, Alberta

Adapted from: Maps produced by T.G. Sommerfeldt and M. Pozluk, Agriculture Canada

Boundary lines have been generalized.

(c) High precipitation.

(d) Irrigation and canal seepage.

In the irrigation districts, the primary causes of salinity are identified by Agriculture Canada[9] as:

(a) Canal Seepage

In Alberta 70-80% of the saline seeps in irrigation districts are caused by canal seepage.

(b) Poor Water Management and Irrigation Practices

Over irrigation and the formation of ponds on the soil surface is common but Agriculture Canada states that the practice of irrigation, if properly employed, should not contribute to saline seep.

## 2. CONTROL

The methods employed to control dry land saline seep are typically focused on the recharge area and involve minimizing or eliminating excess water. A variety of controls are identified as successful and recommended by Alberta Agriculture.

a) Surface Water Drainage - Draining excess surface water from the recharge area.

b) High Moisture Use Crops - Planting forages in the recharge area will control saline seep by utilizing more water than cereal crops. In addition, it is recommended that the discharge area or seep be seeded with salt-tolerant grasses.

c) Recropping - The traditional two year crop - fallow rotation over time, contributes to the salinity problem by increasing soil moisture. Continuous cropping utilizes soil moisture to the fullest extent, and reduces water percolation into the water table.

d) Snow Management - The uniform distribution of snow over a field reduces the erosion potential by wind during the winter, contributes to adequate soil moisture and supplements spring moisture conditions. Shelterbelts and other barriers that trap precipitation should be removed from the recharge area.

Agriculture Canada states that "Generally, lowering the water table and removing salts from the soil are the first requirements in the restoration of land productivity."[10] This applies to saline problems on both dry land and irrigated land. With regard to controlling canal seepage, a number of methods can be employed. The canal can be lined, relocated or rebuilt and appropriate maintenance practices can also minimize the seepage problem.

Over irrigation is particularly serious on soils which have a poor drainage capacity. As a result of the increasing soil salinity problem, lands proposed for irrigation are now being carefully assessed prior to constructing an irrigation system. A complete survey of soil salinity is required before new land can be approved for irrigation.

As with dry land, appropriate crop rotations and the limited employment of summer fallow at the recharge area is important in irrigated areas as well.

## 3. IMPEDIMENTS TO CONTROL

Unlike soil erosion by wind, saline seeps are easily identified and their extent can be measured. Also, the farmer can determine

the amount of crop loss from a saline seep and translate that into lost income. The adoption of saline seep control measures does not seem to require the long-term commitment and attitude change that farmers face when dealing with the problem of soil erosion by wind. The programs available to assist the farmer in controlling saline seep are also very immediate and action-oriented and this is a factor in their ready acceptance.

## IV. CONCLUSION

The one common factor affecting the extent of soil degradation by wind, water and salinity is the practice of summer fallow. As stated, this is a traditional practice that has been employed for many decades. The main reason for using the crop-fallow system is moisture conservation. It is suggested that if parts of the Calgary Region (eastern Wheatland) and the Brown Soil Zone in the southeastern part of the province continue to experience low annual precipitation rates, the movement away from summer fallowing will be a slow process and the soil erosion and salinity problems will continue. Where soil moisture conditions are better, like in the M.D.s of Rocky View, Foothills and western Wheatland, the demonstration programs and incentives will have a greater impact on changing farm operations and the trend in these parts of the Province is expected to be toward decreased summer fallow and increased minimum tillage or continuous cropping. Many impediments to utilizing conservation farming practices have been cited herein. It is not believed likely that these will change significantly enough to foster more widespread acceptance of new techniques. However, the overriding impediment is the scepticism of the farmer to adopt a system with increased costs and increased risk. The demonstration projects should serve to illustrate the long term benefits of conservation farming practices.

APPENDIX A

## POSITIVE ACTION

The Province has initiated a number of programs designed to assist the farmer in assessing the viability of and implementing conservation farming practices for the prevention of soil erosion and salinity control. The programs discussed below focus on a "hands on" approach which is different from the funding or grant programs offered in the past. The following list does not include all of the programs available to the Alberta farmer but focuses on those that provide assistance in evaluating and employing new techniques that control soil erosion by wind and soil degradation by salinity.

### 1. SOIL CONSERVATION AREA PROGRAM (SCAP)

The Soil Conservation Area Program is designed to encourage the implementation of soil conservation projects in Alberta that prevent or control soil erosion and salinity. There are three aspects to the program - wind erosion, water erosion and salinity.

Assistance is provided to prevent and control soil erosion by wind or water and to reclaim affected lands. Eligible expenditures include surveys and designs, construction equipment transfer and seed. Consultant costs applicable to individual projects are also eligible for cost sharing.

Assistance is provided to decrease salinity levels, increase production on saline affected lands and minimize the extent of salinity. Eligible expenditures include investigation and design, seed and seeding costs and drainage system installation costs.

No program budget is set for SCAP as applications are made through the Agriculture Service Boards and the amount of funding

available is set by the municipality. The initial consultation or technical assistance is provided free of charge through Alberta Agriculture but the implementation of recommendations is often a 60-40 split with the Agriculture Service Boards absorbing 60% of the cost and the farmer absorbing 40%. These are general guidelines and the individual Agriculture Service Boards have the option to alter the cost-share conditions.

2. DRYLAND SALINITY INVESTIGATION SERVICE

This sevice is provided through a co-operative effort between Alberta Agriculture, the Agriculture Service Boards, the Prairie Farm Rehabilitation Administration (Agriculture Canada) and the Dryland Salinity Control Association.

The objective of the investigation sevice is to identify dominant discharge areas and causes of excess water and to recommend control measures.

3. FARMLAND DEVELOPMENT AND RECLAMATION PROGRAM (FDRP)

Technical and financial assistance is provided to the farmer for the development of on-farm water management projects and demonstration projects. The program was initiated in 1985 and like SCAP, no budget has been established as it is funded through the Agriculture Service Boards and municipalities with the Agriculture Service Board absorbing 60% and the farmer 40%. All water drainage projects in the Province require licensing through Alberta Environment and it is therefore recommended that the surveys and designs be done under this program to ensure compliance.

4. CANADA ALBERTA AGREEMENT ON RESEARCH AND TECHNOLOGY TRANSFER

This program was initiated in 1988 and will be completed by March

31, 1993. This is the first Federal-Provincial cost share program of its kind. It will be a 50-50 cost share project with a total budget for the 5 years of $4 million. The research component will be run from the Agriculture Canada Research Station in Vegreville. $1 million of the total budget will be allocated to this phase. An additional $2 million will be available from the Federal government, outside the cost share agreement. The applied research component will consist of on-farm demonstrations and technology transfer. The program will provide funding to Agriculture Service boards, agencies such as Alberta Conservation Tillage Society and the Dryland Salinity Association, other applied research associations and individual farmers to do demonstrations. Applications will be reviewed and a theme of long term soil conservation will be a requirement for proposals to be considered. $3 million of the total budget will be allocated to this component. These projects, focusing on soil compaction, nitrogen fixation and reduced tillage, run out of three locations across the Province.

5. FARMING FOR THE FUTURE

The program is committed to agricultural research to improve net farm income and the long-term viability of agriculture in the Province. Farming for the Future was created in 1977 and project funding began in 1978. Farming for the Future has two components: the Research Program initiated in 1978 and the On-farm Demonstration Program initiated in 1982. Total funding for the programs from 1978 - 1992 is approximately $65 million. Both programs cover a wide spectrum of issues including Crop Research, Soil and Water, Livestock Research and Socio-Economic Research.

The Agricultural Research Council of Alberta is Farming for the Future's administrative body. Alberta Agriculture's Research Division serves as the operational arm of the Council. The Division administers projects, and disseminates information on project results and on Farming for the Future.

## 6. ALBERTA CONSERVATION TILLAGE SOCIETY

The objective of the society is to promote reduced tillage practices and demonstrate the effectiveness of reduced tillage or continuous cropping in reducing soil erosion. The society receives some funding from the Conservation and Development Branch of Alberta Agriculture and is currently involved in three demonstration projects in and around the Calgary Region; north of Airdrie, near Blackie and near Drumheller. These projects are field scale comparisons of yields achieved from continuous cropping versus the traditional two year crop-fallow rotation.

## 7. SOIL AT RISK - CANADA'S ERODING FUTURE

At the federal level, in 1982, the members of the Standing Senate Committee on Agriculture, Fisheries and Forestry began investigating the problem of soil degradation across Canada. A series of public meetings were held across Canada. The report, Soil At Risk, served to address two objectives: to raise public awareness of the issue of soil degradation and to improve communication between the public, farmers, government and environmental agencies.

## 8. LOCAL INITIATIVES

The M.D. of Rocky View is currently involved in developing a computerized data base to be used in the administration and enforcement of the Soil Conservation Act. The data base will serve to identify areas of soil degradation and improve awareness of the problem among farmers and agriculture representatives. The program consists of the following five steps:

- aerial photo interpretation and assessment of problem areas;
- field truthing the above mapped information;
- surveying and interviewing farmers;

- mapping the information in visable form; and
- entering the information into AutoCad.[11]

This is the first program of its kind and employs innovative mapping techniques to clearly identify problem areas and assess appropriate remedial measures.

## FOOTNOTES

1. Personal Communication: John Timmermans

2. Factors Affecting Summerfallow Acreage in Alberta: Marv Anderson and Associates Ltd. and Environment Council of Alberta; 1981

3. Personal Communication: John Timmermans

4. Conservation for Profit: Hoechst Canada Inc; Regina; 1984

5. Soil Organic Matter: Alberta Agriculture; AGDEX 536-1; 1985. J. Luckacz and D. Penney. Personal Communication: John Timmermans.

6. Soil At Risk - Canada's Eroding Future: A Report on Soil Conservation by the Standing Committee on Agriculture, Fisheries and Forestry to the Senate of Canada; Ottawa; 1984.

7. Dryland Saline Seep Control: Alberta Agriculture; AGDEX 518-11; 1986.

8. Management of Saline Soils under Irrigation: Agriculture Canada; Publication 1624/E; 1988.

9. Ibid

10. Ibid

11. Personal Communication: M.D. of Rocky View Agriculture Service Board; Herb Plain and Lorie Winter.